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A brief History and Some Perspectives of Ball Planting

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A BRIEF HISTORY AND SOME PERSPECTIVES OF BALL[1] PLANTING

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"The forester must use biological and economic knowledge and, according to the situation, plan his method of afforestation in the direction which is optimal at the present time and under existing conditions".

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[1] In this paper we use the expression "ball" for any kind of separate growing medium around root system. The expression "container" we use only for a surface covering of the growing medium.

INTRODUCTION

Reforestation using small tree seedlings reared in small discreet containers and planted with the roots enclosed in a ball of rooting medium, with or without the container, offers potential advantages over bare-rooted stock. Some of these are detailed below, and have long been recognized. Forest Managers naturally wish to realize some of these potential advantages. As a result, the last decade has seen intensive research and development with pilot and operational trials.

At this stage, in North America, there seems to be a tendency to overlook the history of ball planting. This brief overview attempts to place the current active research into an overdue perspective.

As with every idea in the world, ball planting is not new. The method has been known and used in forestry for nearly 300 years. The earliest reference concerned transplanting of oak wildlings in 1725 (Fischer, 1944). During the ensuing period, development has proceeded according to the site conditions in which planting was done and utilizing improved technology in recent times. The names given to the method are various but involve a fundamentally similar technique: ball seedlings (Ballenpflanzen - Fischer 1944, Reuter 1904, Bitterlich 1963, Junack 1950, Jugoviz 1931, Schreiber 1953, Surber 1964, etc.), seedlings with balled root system (Skoupy 1965, Lokvenc and Skoupy 1967, Macku 1917, Zachar 1965, etc.), tubed seedlings (MacLean 1959, Day 1970, etc.), container seedlings (Kennedy private comm., Johnson 1967, Soos 1967, Carman 1967, Chedzoy 1967, etc.), bullet seedlings (Ackerman et al 1965, Walters 1961, etc.), and assisted seedlings (Endean private comm.). Basically these all relate to seedlings grown or planted in a piece of suitable rooting medium.

Planting of bare-rooted seedlings still has predominance but increasing numbers of foresters in many countries are attempting to do the majority of their planting with balled seedlings. In the last 20-25 years especially, ball seedlings have been tested extensively in afforestation in an attempt to ensure optimum conditions for growth and development of seedlings, to reduce mortality to a minimum, and thus lower the costs. In addition, the use of ball seedlings decreases dependence on weather, offering a considerably longer planting season and therefore the opportunity to utilize permanent and experienced work crews. This in turn improves the quality of the planting and provides a feeling of responsibility for the work carried out.

Historical Chronology

The first known use of ball seedlings was in central European countries during the 18th century. These were the so-called "Clod seedlings", which were excavated with special concave spades from natural regeneration or from special seeding close to afforested areas. Seedlings up to a height of 1 m. or more (3-4') could be transplanted in this way.

Later, young seedlings were transplanted into and grown further in balls of specially prepared rooting media: soil, peat, saw-dust, or various mixtures. The moist mixture was formed by hand or with simple machines and usually placed in the sun and left to dry. The dimensions of these balls range from 4-6 x 6-11 cm. to 30 x 15 x 10 cm. and their durability is about 3 to 6 months. Soil balls are used mostly in tropical and sub-tropical countries (Goor and Barney 1968, Pinacho Bolano 1968, Souleres 1958, etc.).

In northern and temperate zone countries, peat bricks or blocks are used, mostly about 10 x 10 cm, or 15 x 15 cm. with a centralhole for planting or seeding. The peat brick method was developed primarily in Germany (Houtermans 1953,

Roosen and Thurnau 1957, Fröhlich 1959, Sachs 1959, Forster 1963, Hofmann 1959, Prüfert 1959). Good results were also obtained in other countries (Vaage 1964, Lokvenc and Skoupy 1967). The advantages of peat blocks lie in adaptability to mechanization (many special machines were developed), good water capacity of peat, and, in places where there are large peat deposits, cheap local material. The main disadvantage is poor durability.

Durability of such peat blocks may be improved mechanically. In California, Schubert and Douglas (1959) used two plates of porous material to enclose the block with the seedling. Wittly's modification of peat bricks are so called "peat pellets", manufactured by Jiffy-pot Company in Norway and Jiffy-pot Company of America (Jiffy 7's) (Hermann 1969). This pellet is a small, easily stored disc of compressed peat encased in a thin plastic net. After a few minutes soaking in water, the disc expands to a pellet of about 4.5 cm in diameter and about 5 cm high and is readily prepared for seeding. Growth of seedlings in such pellets is good, and development of the method is intensive.

The third main type of ball planting utilizes a container or cover formed from various materials. It is currently the most popular type and is widely used in many countries. Contents of the container, the rooting medium, may be any of the fore-mentioned substances. According to local resources and economic situations, the material used for the containers varies greatly. The following materials are in wide use:

Veneer and wood residue (Goor 1955, Parry 1956, Bitterlich 1961 and 1963, Goor and Barney 1968).

Wire net, tin (Goor 1955, Parry 1956, Suri and Seth 1959, Goor and Barney 1968).

Earthenware or concrete pots, (Reuter 1904, Goor 1955, Parry 1956, Suri and Seth 1959, Goor and Barney 1968, Khan 1969).

Local natural materials - bamboo, sunflower stalks, leaves, moss, etc. (Goor 1955, Parry 1956, Letourneux 1957, Suri and Seth 1959, Goor and Barney 1968).

Paper (Reuter 1904, Oramas 1942, Kimbrough 1949, Parry 1956, Dopper 1959).

Peat and various mixtures with peat (Fröhlich 1959, Børresen 1961, Toman 1961, Lacaze 1962, Vaage and Børresen 1962, Volna 1963, Delvaux 1963, 1968, Münsterhjelm 1964, Tyystjärvi and Salkola 1964, Zachar 1965, Liptak 1965, Skoupy 1965, Lokvenc and Skoupy 1967, Hall and Richmond 1969, Hermann 1969, Brown and Low 1969).

Plastics (Parry 1956, McLean 1959, Walters 1961, 1963, 1969, Volna 1963, Williamson 1964, Crossley and Carman 1964, Kudrjavcev 1964, Ackerman 1965a, 1965b, Ackerman et al 1965, Carman 1967, Johnson and Marsh 1967, Soos 1967a, 1967b, Reese 1968, Mackinnon 1968, Johnson and Dixon 1968, Donald 1968, Brown and Low 1969, Kinghorn 1970).

Use of a more or less rigid container for the rooting medium facilitates transport and handling of the seedlings and hence mechanization. However, such use raises the question of the proper disposal of the container at planting time. Degradable containers, of vegetable materials or unfired clay, may be planted with the seedling, but non-degradable plastic or metal containers should be removed. Even degradable containers may seriously impede initial establishment by delaying root egress and penetration into the natural soil.

DISCUSSION:

Types of Ball Seedlings

The bibliography illustrates that interest in ball planting is very wide and of long standing. Variability in materials used and techniques of production are great and this short outline cannot discuss details of all the variations, but some generalities can be drawn.

In principle we may divide all variations into two basically similar groups:

1. methods which are more suitable from the biological point of view; and
2. methods which are more suitable from the economical point of view.

Some methods, of course, are compromises.

In the first group we may rank all methods which have a cover or ball made from materials that are easily and quickly penetrated by the roots (mostly natural materials). Examples are "clod" seedlings, soil or peat balls, bricks, blocks, peat pellets, jiffy-pots, paper pots, and baskets made from natural materials (moss, leaves, branches).

In the second group we may rank the methods which use materials not penetrated or not easily penetrated by roots. These are veneer and wood boxes, earthenware and concrete pots, tins, plastic pots and tubes and some plant materials which in the beginning are not easily penetrated by roots (e.g. bamboo tubes).

Polythene bags, plastic net bags and artificial growing media are special cases with particular problems.

There is no doubt that the method which has most of the biological advantages is that which involves growing the planting stock in peat pots. This method is currently widespread in European countries. Some of the disadvantages of this method (poor durability of pots, weight of pots with seedlings etc.) might be reduced in further development and with improved organization of nursery production and planting.

A related method is the use of peat pellets, which have some advantages over pots. Hermann (1969) cites some disadvantages of these pellets: too rapid development of the root system in 4-6 weeks, such that the root system would be severely damaged by transplanting; seedlings are too small for planting in northern territories, and in southern territories rapidly outgrow such a little ball. These disadvantages would be overcome with greater flexibility in size and shape of the peat pellet.

Any method using peat offers particular economic advantage to northern countries, many of which have great resources of high quality peat. This also offers an opportunity for development of local industry.

Plastic materials offer considerable economic advantages. However, at the present time most plastic tubes, pots, bags, or other containers have many biological disadvantages which sometimes considerably outweigh the economic advantage.

One of these disadvantages is impenetrability of container walls, which then influence the development of root system before planting and often give rise to serious deformations. Small tubes or pots limit development of the root system. In such types of containers, during dry and hot parts of summer the active roots probably partly die away. Upon the return of more favourable conditions, the root system regenerates. Such a cycle may be repeated many times. Limited root development facilitates frost heaving in cold periods of the year.

Tubes or bags with larger dimensions (more than 5 cm in diameter) are much more suitable for growing large planting stock which is necessary for afforestation of marginal sites. On extreme sites where only one postlogging silvicultural treatment can be applied, stock equivalent to a minimum of 2-0 or 3-0 should be used. Container seedlings are primarily suited to such kinds of sites. This method has priority in dry and in erosion endangered sites because the tubes or bags prevent the soil block from washing out or blowing away.

Microclimatic conditions in larger tubes and bags are more favourable. With polythene bags it is necessary to perforate the lower part of the walls and the bottom to improve water and temperature regimes and development of the root system.

A very similar method uses plastic net bags, which give every possibility for good development of the root system but are not so suitable for dry and eroded areas. A potential hazard with net bags lies in choking of roots as their diameter exceeds the size of the holes in a net made from strong plastic.

One of the most promising methods for the future, from the biological as well as from the economical point of view, is the use of artificial growing media. It is very easy to give every form, size, physical or chemical quality to artificial balls. Transport and storage is also very simple. We may use

materials in pre-formed balls or blocks for seeding or transplanting, or in the form of a liquid which, after being poured out in the frame, dries and forms the base for the development of the root system. On the surface of such a bed can be placed a thin seeding layer of peat or compost soil. Seedlings are carefully spaced to permit future cutting out of blocks with seedlings. Cutting is better done early and often, because young roots heal and regenerate readily. It is necessary to make the bottom of such beds from materials impenetrable for roots (e.g. polythene film, with occasional perforations for drainage). Alternatively, undercutting may be practiced. This is known in tropical countries as a Swaziland method (Parry 1956). The use of artificial growing media is a young method and requires further development, but may contribute much towards solving afforestation problems.

Another expanding method is the use of paper pots, which have many economical advantages (cheap production, light weight, simple storage and transport etc.). If the right composition of paper is used, paper pots are also biologically suitable, permitting easy root penetration.

It is not possible to recommend one best method or system of growing planting stock for all types of sites. Every system and method must be adapted to local conditions and to local possibilities.

Rearing of the Planting Stock

Generally, it is possible to distinguish two basic systems for growing of ball planting stock:

1. The first in countries where the climatic conditions are so favourable for growth of seedlings that suitable planting stock may be grown in the open in a few months. These are mostly tropical and subtropical countries, and we may use large balls.
2. The second system is in countries where climatic conditions do not permit rapid growth of good planting stock without special equipment (heating, lighting, cover, etc.). This applies mostly to temperate and northern zone countries, in which a combination of permanent and portable greenhouses and cold frames is necessary.

In the Canadian climate, planting stock of many species can be produced with the following generalized schedule:

1. Seeding in containers.
2. Placing containers in a greenhouse with a day temperature of about 70-75°F and a night temperature of about 50-55°F, with sufficient watering, lighting and fertilization. The length of growing period in greenhouse conditions varies and depends on the type of stock. A minimum of 6-8 weeks is necessary to obtain seedlings strong enough.

3. Placing the seedlings outside in wooden frames or on flat benches with expanded metal bottoms (to ensure air root pruning) under shadehouse.

The period of growing under shade is different and depends on ecological demands of species. Also fertilization regime during the growing period must be changed due to species and stage of development. Seedlings can generally be ready for planting at the age of 6 months to 1 or 1 1/2 years.

If we want to produce large container stock, we can also use a transplanting system. Seedlings are grown in the greenhouse in a small size biodegradable container and after several weeks are transplanted into larger containers and moved outside. Such a system would give us the opportunity to increase production from greenhouse space (about 3,000 seedlings/m^2 in comparison with 150-900 seedlings/m^2 grown in large containers). The transplanting step is a costly operation, however direct seeding in large containers leads to the decrease of production from permanent greenhouse area. The choice of the system depends on the economic calculations (area of greenhouse, cost of manpower, etc.).

For outside shading and watering it is better to use a high system which permits work underneath.

CONCLUSIONS

In forestry no "redemption method" exists which may be used steadily and exclusively. The forester must use biological and economic knowledge and, according to the situation, plan his method of afforestation in the direction which is optimal at the present time and under existing conditions.

This applies also to ball planting methods, which are not optimal in all situations. These methods extend our options, but like other methods are limited to certain minimal conditions (soil moisture, minimal period necessary for rooting of seedlings, competitive ability, etc.).

The aim of afforestation is not to plant millions of seedlings with minimal expenses, but to afforest a certain area. That means, to create a new, fully stocked young stand. The result of the silviculturist's work must be evaluated on the basis of the time, cost, quantity and quality of such new stands. The economy of afforestation must be calculated as the total cost for afforestation operations, including the cost of the planting stock and the loss of growth for the period between cutting of the old stand to the rise of a new young stand.

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